

Aromatic, Medicinal Plants and Vulnerability of Traditional Herbal Knowledge in a Berber Community of the High Atlas Mountains of Morocco

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Abstract: This article compliments the S18 session (transmission of traditional ecological knowledge and conservation of medicinal plants) at the 13th International Congress of Ethnobiology (ISE) in Montpellier, France (May 2012). The aim of the article is to provide an insight into the livelihoods of a Berber community, a village of the High Atlas Mountains of Morocco, of the local biodiversity and most importantly, the prevalent use of medicinal plants for primary health care. It seeks to demonstrate the value of traditional ecological and herbal knowledge for the subsistence of the community and emphasises the vital role that family and community connections play for the transmission of traditional herbal knowledge within the community.

Key words: Aromatic and medicinal plants; Berber communities; Erosion of traditional herbal knowledge; Morocco

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The Maghreb countries represent important biodiversity sites and important zones for the conservation of plant resources. Owing to its biological diversity, Morocco is after Turkey, the second most biologically diverse country in term of species in the Mediterranean basin. In Morocco, there are 162 sites with high biological diversity and identified for development as parks or reserves as part of a national conservation strategy (Fennane, 2004). The High Atlas present a particularly high rate of endemism, also present in the Middle Atlas, but to a lesser extent in the Rif and the Anti-Atlas. The richest sites for locally endemic species are Ifrane National Park, Toubkal National Park, Jbel Bounacher and Jbel Bou Iblane where approximately 7 000 species in 920 genera and 130 families, including an estimated 4 500 species and sub-species of vascular plants are found in the Moroccan flora (Taleb and Fennane, 2011).

The Toubkal National Park was created in 1942 and is the oldest and most protected park in Morocco (Lamnouer, 2002). It is set in 38 000 hectares of

the central part of the High Atlas, between the N' Fiss valley to the West and the Ourika valley to the East (31° 05' N - 07° 50' W). This particular zone displays the highest summits of North Africa. It is readily accessible, frequently explored and the most picturesque summit of the High Atlas Mountains. Seven valleys originate from the Toubkal with streams descending in altitude as they carry snowmelt water across various altitudinal zones and ecosystems, before reaching two major river basins, the Tensift and Souss. The principal summits of the park, situated on the line dividing the watersheds leave towards the east: the plateau of Tazarhart (3 995 m), Ouenkrim (4 089 m), Toubkal (4 167 m), Tichki (3 753 m), Azrou Tamadout (3 664 m), Aksoual (3 910 m), Bou Iguenouane (3 882 m), and Ineghmar (3 892 m). Many permanent rivers have their origin in the park area, and ensure the irrigation of the valleys and the plains in the piedmont. On the northern flank, the main rivers are the N'fiss, Rherhaya, and Ourika, with the Souss on the southern flank. The Toubkal

National Park is considered to be a ‘hot spot’ for biological diversity.

Quite apart from its unique geographical characteristics, the High Atlas also represents an important refuge for Berber communities. Although there is some migration to urban areas, population growth in the mountains is an important feature of human capital. The balance of natural resources has permitted these populations a degree of economic independence. However, living in the area has a number of disadvantages. These are related to topographic compartmentalization, a very fragile environment and a lack of basic infrastructures. In this respect, the High Atlas demonstrates many of the ‘poverty and livelihood’ issues found among mountain communities generally (Crawford, 2003). In particular, the communities are currently experiencing environmental degradation that is both a cause and a consequence of acute rural poverty (Rasmussen and Parvez, 2002), and face considerable obstacles as far as development is concerned. In the Atlas Mountains, living conditions are generally very hard and difficult to improve, mainly because the central government has always privileged the Atlantic coast and its hinterland (Boujrouf, 2003). Furthermore, because these regions face strong environmental constraints, the people and the landscapes have always been changing, shifting, and self-regenerating. The populations are called to manage their environment, something that they do generally well, contrary to the widespread current belief that local people mismanage their resources (Ostrom, 1990; Scoones, 1994; Pretty and Pimbert, 1995; Leach and Mearns, 1996; Pretty and Shab, 1997; Ghimire and Pimbert, 1997).

The study presented here focuses on El Maghzen (Fig. 1), a village in the Agoundis valley situated within proximity of the Toubkal National Park. The

disparity between the cities and these areas is considerable, mostly because the populations are poor, marginalised, and lack the basic infrastructures for development. The inhabitants represent one of the poorest segments of Moroccan society in terms of literacy, infant mortality, availability of potable water, electrification and other development indicators (Russell, 2004). In El Maghzen, the environment is biologically rich and medicinal plants are profuse. Endemic aromatic plants such as Thyme (*Thymus satureioides* Coss), sage (*Salvia aucheri* var. *canescens*) and a species of lavender (*Lavandula dentata* L.) are widespread in the valley. These plants which are one of the few sources of cash income, are harvested during the summer months for both herbal medicine and trade. The plants are then traded down the valley and follows two commodity chains, one official and the other informal and illegal, and is mostly destined for essential oil distillation in Casablanca and Marrakech, and exported to Europe (Montanari, 2004; 2012).

The aims of this article is to emphasise the importance of traditional ecological knowledge in the village of El Maghzen, and in particular to demonstrate the value of traditional herbal knowledge to respond to health issues in the community. It further seeks to demonstrate the vital role that family and community connections play for the transmission and the continuation of traditional herbal knowledge to the younger generations.

1 Research methods

The data relating to the traditional use of the local aromatic and medicinal plants were collected with the inhabitants of El Maghzen^①. Interviews were conducted with 53 women and 34 men of the village to gather information on the vernacular names of the plants, the parts used, the locations where plants

① The data collected in this article are based on the author's PhD thesis at the University of Kent, UK (Montanari, 2012). The thesis offers a critical analysis of the introduction of essential oil distillation in the High Atlas of Morocco with reference to the role of gendered traditional knowledge.

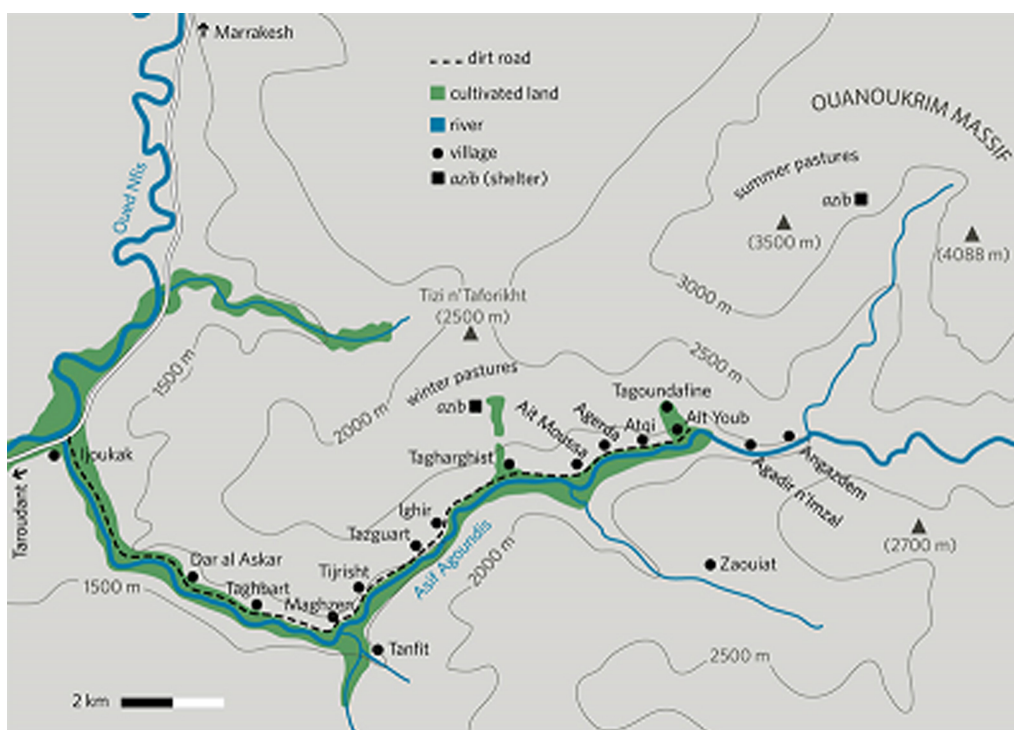


Fig. 1 The Agoundis valley. Cartography© Bart Deseyn

were collected and the medicinal use of plants harvested. Plant free listing were also conducted with these informants to identify the common plant knowledge. Further questions were asked concerning whether plants were always present in the home, the source of interviewee knowledge, the place where knowledge transmission occurred, and if the informant had passed on knowledge to anyone in particular (children, grandchildren, neighbours or others).

2 Plants commonly used in traditional medicine

In El Maghzen, there are no close proximity dispensaries or other forms of treatment and ethnomedicine is prevalent. Some of the plants used have also important phyto-chemical properties. Both women and men in El Maghzen share a common plant knowledge and the transmission of this knowledge through women is entirely within the community. However, the transmission of herbal knowledge and of other traditional subsistence activities is at present vulnerable as the community is increasingly exposed to outside influences and interventions.

2.1 Thyme

Thyme (*Thymus satureioides*) is an endemic aromatic plant that can be found widely distributed in the Mediterranean region, and is used widely in the local traditional medicine. Although it has been estimated that about 350 species of the genus *Thymus* can be found across the world, Moroccan thyme species, —*Thymus satureioides*, *Thymus broussonetii*, *Thymus maroccanus*, *Thymus leptobotrys*, *Thymus willdenowii* are endemic to Morocco, and with *Thymus algeriensis*—have all been used in Moroccan traditional medicine (Jaâfari *et al.*, 2007).

The main applications of thyme are in the treatment of diarrhoea, fever, coughs, and topically in the treatment of infected skin areas and wounds, cutaneous ulcers, and various types of dermatitis. More precisely, thyme has been used and appreciated for its positive effects, i. e. for its nervous tonic and general stimulant properties, producing a euphoric effect, which may be useful to fight off depression, anxiety and insomnia (Bellakdhar, 1996; Ismaili *et al.*, 2001). Further, the application of thyme in massage relieves sciatica, arthritis, lumbago, gout,

neuritic and rheumatic types of pain (Valnet, 1964). Similarly to Tea-tree (*Melaleuca alternifolia*) in its anti-inflammatory and antiseptic properties, thyme applied topically in the correct dilution, speeds up the healing of wounds and inflamed skins, mainly due to the increase of blood flow stimulated by increased oxygen and nutritional substances. Thyme species not only have powerful antioxidant properties but important antibacterial properties as well. Owing to the presence of phenolic agents, thyme essential oil has a direct inhibiting action on pathogenic bacterial strains such as *Escherichia coli*, *Salmonella enteritidis*, *Salmonella choleraesuis* and *Salmonella typhimurium* (Pelnaver *et al.*, 2005), and is widely used in food protection against decay and bacteria. Typically, species of thyme such as *Thymus satureioides*, *Thymus wilddenowii* from Morocco have revealed the presence of major constituents, including a number of flavonoid derivatives of luteolin and eriodictiol, both rare in the Lamiaceae, as well as rosmarinic acid. Further, thyme therapeutic applications extend to the digestive and respiratory systems, relieve gastro-intestinal disorders, facilitating dyspepsia (slow digestion), colic, fermentation, flatulence, diarrhoea, gastritis and gastric ulcers. In terms of respiratory ailments, thyme has powerful expectorant, spasmolytic and antiseptic properties, exerting a strong action for colds, flu and sinusitis, bronchitis in its acute and chronic forms, tuberculosis and a

soothing action over irritable, convulsive coughs (Zarzuelo and Crespo, 2002).

In El Maghzen, thyme (*Thymus satureioides*) is widely distributed in the mountains and local people typically refer to it as *azoukni* in Tachelhit (Fig. 2). This name is given to the plant characterised by its purple flowers, which local people refer to as being a ‘male plant’, as opposed to *tazouknit* (*Thymus pallidus*) which has white flowers, and which local people consider a female plant. *Azoukni* is taken regularly, that is more or less on a daily basis, as a fresh herbal tea infusion during the harvest season (mid-May to mid-July) or outside the harvesting season in the dried herb form. The dried herb is powdered and taken regularly by women for painful menses, to relieve gastric disorders (stomach ache, bile complaints, indigestion, intestinal trouble), and respiratory disorders such as colds, coughs, chills and headache because of its warming character. However, people have cautioned that it should not be taken over long periods of time as it will damage teeth and gums precisely because of its warming character (Montanari, 2012).

2.2 Lavender

Lavender (*Lavandula dentata*) (Fig. 3), and to a lesser extent, *Lavandula multifida*, can also be found throughout the valley. *Lavandula* is a member of the Nepetoideae sub-family in the Lamiaceae family. According to Upson (2002), 32 different species



Fig. 2 Azoukni (*Thymus satureioides*) in flower

Source: B. Montanari © 2008



Fig. 3 Timzuria (*Lavandula dentata*) in flower

Source: B. Montanari © 2008

of *Lavandula* have been described in the literature, with a number of extra species in infraspecific hybrids and taxa. Numerous sub-species and their hybrids are cultivated worldwide for horticulture. The genus is widely distributed throughout the Canary Islands, Madeira and Cape Verde Islands, across the Mediterranean Basin, North Africa, South-west Asia, the Arabian Peninsula and as far as India. Perhaps best known for its popular use in the perfume industry, lavender has also a long history of medicinal use. The name *Lavandula* is derived from the Latin word *Lavare* meaning to wash, as the plant was used mainly to perfume bath water. Chu *et al.* (2001) recognise that at least five different species are used medicinally, each presenting different medicinal properties. It is the essential oils extracted mainly from *L. intermedia* and *L. angustifolia* that are of economic importance in the perfume and fragrance industries. *L. latifolia* and *L. hybrida* (*L. latifolia* × *L. angustifolia*) are used to produce spike lavender oil and lavandin oil. In vitro, lavender oil has shown antimicrobial activity against bacteria, fungi and some insects (Kim and Lee, 2002). Its spasmolytic activity in smooth muscle *in vivo* supports its historical use as a digestive aid. Although *Lavandula* does not possess potentially powerful antioxidants like thyme or other plants of the Lamiaceae family, it presents nonetheless potent anti-carcinogenic, analgesic and anti-allergic properties.

In El Maghzen, the flowers of *Lavandula dentata* or *timzuria* in Tachelhit are used extensively along with other herbs in tea, coffee and in infusion. Its main application is for headache, stomach, painful menses and gynaecological problems ... etc. Women add *timzuria* for its fragrance to henna mixtures either for tattooing or for hair colouring. It tends to be extensively collected for cow fodder (Montanari, 2012).

2.3 Sage

Another aromatic plant in the Agoundis valley is sage (*Salvia aucheri* var. *canescens*). It is endemic to the High Atlas (Taleb and Fennane, 2008). Of

the Lamiaceae family, *Salvia* is the largest and the most important genus with a distribution of about 900 species worldwide. Sage has been used as an important medicine since the earliest times and has been extensively documented back to the Roman era, particularly *Salvia officinalis*. The name *Salvia* comes from the Latin 'Salvus' meaning safe. Traditionally, the various species of sage have been applied in skin and hair care, as an antifungal, to treat skin conditions in bathing and washing, for wound treatment and rheumatism, for varicose and leg conditions, for nervous and mental conditions, to stop milk production in nursing mothers and for feet and pedicular problems (Dweck, 2000). *Salvia* presents rich sources of polyphenolic flavonoids and phenolic acids, unique to the genus (Lu and Foo, 2002), and has a high content of useful secondary metabolites, including terpenes and phenolics and their derivatives. Other reputed spheres of action for *Salvia* are beneficial effects on memory disorders, depression and cerebral ischemia.

In El Maghzen, the vernacular name for both *Salvia aucheri* and *Salvia officinalis* is *salmia*. While *Salvia officinalis* is grown in gardens, the collection of *Salvia aucheri* occurs at the same time as *azoukni* (*Thymus satureioides*) when villagers spend most of the day collecting the plants in the mountains. It is often used in tea or coffee in combination with other plants. Its main applications are for stomach and intestinal discomfort, backache, to improve circulation, for vertigo, diabetes, against vomiting, and it has a relaxing effect on the gall bladder. As with thyme, people have warned that it should not be used excessively because of its warming character.

2.4 Other plants traditionally used

Other plants widely used in the traditional pharmacopeia are *Artemisia* (*Artemisia herba-alba* Asso), *Chenopodium* (*Chenopodium ambrosioides* L.), *Cistus* (*Cistus salvifolius* L.), *Globularia* (*Globularia alypum* L.), *Horehound* (*Marrubium vulgare* L.), *Inula* (*Inula montana* L.), *Iris* (*Iris germanica* L.), *Lemon Verbena* (*Lippia citriodora* Kunth),

Madder (*Rubia peregrina* L.), Pennyroyal (*Mentha pulegium* L.), round leaved mint (*Mentha rotundifolia* L.), and Thuya (*Tetraclinis articulata* (Vahl) Masters).

Artemisia, *shich* in Tachelhit, belongs to the Asteraceae family. Artemisia is widely used in Moroccan traditional medicine. In the village, it is mainly used for colds, lung complaints, stomach and intestinal discomfort, vomiting, vertigo, bile complaints, headaches and tooth ache, especially after extraction. The whole plant without roots is often used in tea or coffee. It is also applied as a powder for facial spots. It has other uses as a vermifuge, emmenagogue, diuretic, intestinal tonic, cholagogue and anti-diabetic (Montanari, 2012). An essential oil is extracted, of which the main components are thuyone, camphor and flavonoids, varying in chemotypes according to the geographical situation. The plant is, however, toxic in strong dosages and can provoke vertigo and convulsions (Bellakhdar, 1996).

Chenopodium (*Chenopodium ambrosioides*) or *mhinza* in Tachelhit, belongs to the Chenopodiaceae, and is widely distributed on river banks. The leaves mixed with water or onions are applied to the head for headaches and fever, particularly for children's ailments. The dried powdered leaves are drunk with a little water for migraine, and the juice extracted from the leaves and mixed with orange juice is drunk for fever and stomach ache. The juice is a very sticky and potent plant medicine which local people know exactly how to administer as it is also given to children (Montanari, 2012). A well-known use for Chenopodium is as a vermifuge, acting as an active anthelmintic for the expulsion of round worms, especially in children. For this purpose, the whole plant is employed (Grieve, 1931/1980). However, Chenopodium may be included in small quantities in herbal mixtures for the treatment of fevers and headaches.

Cistus (*Cistus salvifolius*), or *irguel* and the female plant *tirguelt* are widely used in the valley. *Irguel* is administered for stomach, intestinal discomfort,

menstruation, chills and rheumatism, for lack of appetite and to put on weight. It is also considered as an aphrodisiac. The leaves are mixed with *taseft* roots (*Quercus ilex*) for stomach ache and for warming. The crushed seeds mixed with water are taken for chills, menstruation, the seeds mixed with milk or soup for rheumatism. It is an important ingredient of *slilo*, a pleasant compact mixture of flour, honey, olive oil, mashed almonds and walnuts and powdered *irguel* seeds, consumed in winter or during celebrations such as weddings and Ramadan, served with tea as an appetiser. *Slilo* with *irguel* seeds has the reputation for helping women put on weight. For this reason, it is prescribed for lack of appetite (Montanari, 2012).

Globularia (*Globularia alypum*), or *tirka* in Tachelhit belongs to the Globulariaceae and grows in the mountains. It forms bushes with blue flowers resembling globules. In the Agoundis valley, people refer to it as 'Berber tea' even though the leaves and flowers are mainly added to coffee and only to a lesser extent to tea. It is often mixed with other plants because it has a strong taste. Its main medicinal applications are for stomach ache, headache, menstruation, diabetes and vomiting. It is also mentioned as part of a mixture to calm sexual excitability (Montanari, 2012). It is used as a treatment for diabetes (Bnouham *et al.*, 2002; Jarald *et al.*, 2008), but has to be administered with care as it can be toxic, provoking vertigo, oliguria, diarrhoea, aching members, hypothermia and slow pulse rate.

Horehound (*Marrubium vulgare*), or *ifzi* in Tachelhit belongs to the Lamiaceae. It is an emmenagogue, expectorant, febrifuge, sedative, and stomachic. Locally, people use it for diabetes in the form of tea, using the whole plant without the seeds. For stomach ache and worms, the juice from the leaves is mixed with a little water and sugar. A mixture of leaf juice and olive oil is inserted in the ear canal for earache, and the powdered leaves with water and sugar for headache. A decoction is often prescribed as anti-typhoid, anti-icteric, acting as a ton-

ic and stimulant. Further external uses are for abscesses and boils where the plant is applied in poultices (Montanari, 2012). Use of the plant to treat diabetes is supported in the literature (Eddouks *et al.*, 2002).

Inula Montana or *ija oumghar* in Tachlehit, belongs to the Asteraceae, and is considered the queen of the warming herbs. It is found widespread in the mountains surrounding the village. Its main use is for colds, chills, and lung problems. The leaves are added to hot water, coffee or tea or mixed in hot milk. It can also be used for insomnia taken with hot milk. A further use is for aching eyes where the roots are left to stand in milk. *Ija oumghar* is a recommended addition in herbal mixtures to address cold and chilling conditions. People have warned against overuse because of the damage that it can cause to teeth, presumably for its warming effects (Montanari, 2012).

Iris (Iris germanica), or *soussban* in Tachelhit, belongs to the Iridaceae. Irises are found in most walled terrace gardens, throughout the valley. Because of their rhizome system, they play an important role in soil fixation. The plant possesses many therapeutic properties in traditional medicine, including anti-spasmodic, emmenagogue, stimulant, diuretic and aperient actions. Dropsy and gall bladder diseases can be relieved with a decoction of the root, and the juice of the rhizome is very effective for the removal of skin freckles and sores. Further uses include blood purifying virtues and as a sound treatment for venereal diseases. *Soussban* also produces an essential oil with important compounds such as flavonoids, isoflavonoides and their glycosides, benzoquinones, triterpenoids and stilbene glycosides. In particular, the iridals contained in the rhizomes have exhibited a potent pesticidal action and potent anti-cancer activities (Asgahr *et al.*, 2009; Rhaman *et al.*, 2002). The use of *Iris germanica* is well known in the pharmaceutical and cosmetic industry and has already been granted a few patents for its anti-wrinkle properties and transformation methods (Patent US 6, 224, 850 B1, 2001.

Patent US 6, 459, 017 B1 2002). In the villages of the Agoundis valley, the roots of *soussban* are collected, cleaned and sold in the local souk. It can fetch up to a few hundred dirhams per kilo.

Lemon Verbena (*Lippia citriodora*) or *luisa* in Tachelhit belongs to the Verbenaceae. The genus contains approximately 200 species, shrubs and other small trees. Traditionally prepared in herbal tea, it enjoys a long history in folk medicine because of its antispasmodic, antipyretic, sedative and digestive properties. *Lippia citriodora* contains essential oils, from which geranial, neral and limonene are extracted and it is believed that phenolic compounds (flavonoids) are responsible for the therapeutic properties (Argyropoulou *et al.*, 2007). Further studies on *Lippia* essential oil have revealed antimicrobial activity (Pascual *et al.*, 2001), activities primarily derived from leaf oil extraction. Although not an endemic plant of the High Atlas, it is found cultivated in profusion in gardens all around villages. As its name suggests, it has a strong lemon scent. Its main applications are for insomnia, headaches, and restlessness in babies, blood circulation and stomach ache. The whole plant without roots is utilised in infusion or tea. Therefore, *luisa* can be added to herbal mixtures to address insomnia, sleeplessness and agitation.

Madder (*Rubia peregrina*) belongs to the Rubiaceae. Its vernacular name in Tachelhit is *tarubiya*. *Tarubiya* is found mainly in stonewalls forming terraces and around gardens. In the village, the dried roots are used for circulatory and heart problems, and for childbirth. It gives food a red colour when used in *tajine*. Other uses of the plant include jaundice and liver ailments, and to fortify blood. The roots are further used as a diuretic and emmenagogue to induce menses. An essential oil can be extracted from the plant, rich mainly in anthraquinones. It is widely used in dyeing processes to obtain a red colour for leather or wool. In a dried form, *tarubiya* is an interesting addition to any mixture treating circulatory problems.

Pennyroyal (*Mentha pulegium*), or *fliyyo* and

round leaved mint (*Mentha rotundifolia*), or *timijja* in Tachelhit, are mints belonging to the Lamiaceae family, and found widespread close to water or damp places. The plants are used in inhalation, thoracic cataplasms for lung infections and are considered the plants ‘par excellence’ for winter ailments because of their warming qualities. *Fliyyo* is further employed for delayed menses and for promoting menstruation (Bellakhder, 1996; Potterton, 1993). Both plants’ main use in the village of El Maghzen are for colds, chills, coughs, stomach ache and dyspepsia, and it is employed as the whole plant without roots in milk, tea or coffee. It is often part of a mixture with other plants in tea. Although the plants come from the same family, there are differences in the oils that the plants produce. *Fliyyo* and *timijja* are endemic to the Agoundis valley and found profusely by the river and in irrigated gardens. Both plants are a valuable addition to any dried herbal mixture prescribed for colds, coughs and chills, and when added to other plants for amenorrhea or dysmenorrhoea (Montanari, 2012).

Thuya (*Tetraclinis articulata*), or *azouka* in Tachelhit, is endemic to North Africa. Thuya possesses many properties and is used in traditional medicine. Local people use it for headaches, often mixed with henna and applied to the head, stomach ache, lack of appetite, bile problems, high blood pressure, vertigo, sickness, children’s headaches, gynaecological problems, diabetes, fever, colds, chills and lung problems. The main method of preparation is to make a powder from the dried leaves, and then add this to tea, coffee, sour milk or soup, or to inhale as a fumigant (Montanari, 2012). A sticky resin named sandarac or *ar’ar* in Arabic or commonly referred to as *sandarac gum* is extracted from the bark. In the past, its prime application was in the production of varnish and as a useful added ingredient in lacquers, adhesives and paints. It was mainly exported to Europe for industrial and pharmaceutical purposes. Today, it has an application in dentistry and is used to fill decayed or damaged teeth. Powdered leaves can be applied externally to

heal wounds, and to close-up the wound of newborn babies’ umbilical cord. Women in Essouira region tend not to use thuya because of its warming, emmenagogue properties as it may cause an abortion in pregnant women (Kaleta, 2008).

3 A society still ruled by its traditional customary system

In El Maghzen, the traditional autonomous customary law, the *jama’a*, still largely rules the community. Traditionally, the *jama’a* is based on oligarchies or small political and administrative entities on a given limited territory, composed of *amghar* (a local figure holding a government position) and *taqbilt* (a tribe or political unit). The village *jama’a*, comprises in fact two councils, one consisting of a small group of elders representing each lineage in the village, and another, a larger body where a male member represents the household. The *jama’a* (*lajmaa’t*), composed of between three to ten or more lineages, is a territorial unit comprising one or more villages (*douar*), whose control and jurisdiction is spread over its territory (Madhi, 1999). Identified by Montagne (1930) as the ‘Berber Senate’, this vital body regulating administrative, legislative and executive functions over social and environmental matters is governed by an assembly of households’ male representatives who meet in each village in the mosque to discuss matters informally, usually after prayer on Fridays. Above all, it is formed by those who recognise, and indeed are recognised by the community as acting for the common interest of all, on both a material and spiritual level. Although never codified, this governing body was previously applied flexibly for solving problems of resource use and played a vital role in resolving disputes, mobilising and regulating collective work. It regulated not only individual access but also collective access, and was integrated into the cultural and political life of the community (Id Balkassm, 2002). It was also a vital element in keeping together different lineages, households and other village members for work in

situations where survival entailed cooperation in a particularly harsh environment.

In the past, the inhabitants of El Maghzen had collective rights of access to the land for their subsistence needs, e. g. harvesting medicinal plants and collecting wood for fuel and building material. However, the national government claimed to own the land and the Department of Water and Forestry was assigned the task of control during the French colonial period (1917). Since then, village residents have had limited access to their traditional lands, and can only collect medicinal plants for personal use and for the collection of dead wood. Currently, if local people are caught collecting for trade, they are fined by the Department's representative. Although in recent years, the authorities have encouraged the transfer of this traditional customary law to a more formal form of association, e. g. a non-governmental organisation, to facilitate cooperation with outside organisations such as development agencies (Downs, 2003), people still refer to it and follow directives regarding land access, whether land is used as collective pasture or not (Venema and Mguild, 2002: 109). At present time as well as during the Protectorate, people have fallen back on the customary law to access the resources in times of conflict and confusion over land access. Even though the authorities may formally control resource access and use, in practice this does not happen (Montanari, 2013: 56).

4 Traditional ecological knowledge practices

In El Maghzen, as in most other traditional societies, the traditional knowledge transmission is both *horizontal* between the members of the same generation, and *vertical* between members of different generations, stereotypically between parents and their offspring (Guglielmino *et al.*, 1995). It is vital for the maintenance of the land, water and biological resources upon which people depend, and enters into decision-making chains at every stage in production, management, distribution and consumption (Berkes *et al.*, 2000; Ellen, 2011; Folkes,

2004; Grenier, 1998; Turner and Garibaldi, 2004).

4.1 Traditional agriculture

The Agoundis valley, enclosed between abrupt forested slopes, is one of the narrowest and most enclosed valleys of the High Atlas and offers very little cultivable space. The strong declivity of the slopes favours the streaming and erosion of the ground, thus necessitating the construction of terraces. Local families have traditionally diversified livelihood strategies according to the seasons mainly because of the altitude ranges, and integrated terrace agriculture has allowed the local population to subsist on diversified rotation agricultures (Barrow and Hicham, 2000). This human modification has shaped over thousands of years the typicality and diversity of these landscapes and contributed to the control of erosion and the promotion of agriculture, resulting in a remarkable anthropic landscape (Gerbaty, 2004). Farming activities take place in terraced fields cut into the steep valley sides and for centuries, the villagers of the High Atlas have practiced a mixture of subsistence cultivation and pastoralism. The number of terraces is more or less equally divided between the households and gardens are well-delineated due to the restricted space for cultivation (Fig. 4). The main crops in the gardens are wheat and barley, harvested once a year during the summer, and more recently alfalfa (*Medicago sativa*), which is collected mainly for cow fodder. Only cow and chicken manure is added once a year, and crops are often companion-planted in groups of two or three cultigens, for example, tomatoes with maize and peas, broad beans, onions and egg plants in the absence of chemical pesticides (Fig. 5). Sowing, weeding and harvesting are mostly done by women in the gardens, while men tend to be involved with the duty of ploughing. This work is mainly undertaken using a donkey or a mule and traditional plough, which does require a certain amount of strength to push the axle of the mill and the control of the animal. Wheat and barley is harvested by both men and women during the summer (May, June) and involves cutting the



Fig. 4 Little terrace garden where every space is used

Source: B. Montanari © 2007

wheat and barley to be carried back to the village terraces for drying.

Although the reliance on local resources tends to be heavy, the inhabitants of El Maghzen have always been self-sufficient and techniques for managing the land and other natural resources have changed little over the centuries. Over time, the population has adapted and shaped the landscape according to its needs and flexible mechanisms have been developed—terracing, irrigation, pasture management, transhumance, crop selection. These have allowed the community to survive difficult (including extreme climatic) conditions using the resources at hand (Montanari, 2014). Gardens provide the basic crops to feed the family, but are also a recreational space and women usually make pre-arrangements for meetings. In the spring and summer, families will spend a considerable amount of time in the garden and a younger member of the family would usually bring food and tea to the garden.

Although women's outdoor activities reflect the harshness of daily existence, many activities are collective and group cohesion is very important in the community. Women will often gather and go down to the terraces together, and reap either alone or with other family members. Although men are also involved in harvesting wheat and barley from the terraces, the wheat and barley processing done by men



Fig. 5 Typical cultivation of tomato plants growing on reed frames with egg plant (*Solanum melongena*)

Source: B. Montanari © 2007

is quite different as they are more involved in threshing. The collection of wood is either a female or male activity, in which a group of young children and young adults team up for the task, loading the donkeys and mules with chopped wood before returning to the village at dusk. Cow fodder collection also occurs in the mountains and groups of between two and four women may collect together. It requires traipsing long distances over the mountain slopes and carrying the fodder back to the village. Cattle fodder collection also occurs from the gardens, and while these are closer to the village, it still requires carrying bales of fodder on the back. The feeding of animals is undertaken within the village which is close to home and usually takes place early in the morning or later in the afternoon.

4.2 Traditional water management

There are different types of collective water resources and the water distribution shows the importance of traditional water management practices. These consist primarily of the Agoundis and Ait Ahmed oued (streams). Although the Fonds International de développement de l'Agriculture (FIDA) and the Agence de développement solidaire (ADS) have in recent years replaced the old traditional system by an hydraulic unit for collective management defined by a central *targa* (irrigation canal), and fed by a water pump coming from an artificial pool

(or a water catchment), associated with a more recently-built cement dam, two types of traditional water distribution system still prevail.

The first called *tawala* supplies water on request when it is abundant, particularly during springtime. The second called *nouba* is the most common system in which distribution is based on water rights and allocation is timed according to lineage. The allocated time varies from half to a whole day, depending on the accounting unit from the artificial pool. Water originating from villages higher up the valley is diverted from the river to irrigate the terraces of lower villages through an intricate branching system. Men undertake heavier and more complex structural tasks, such as the maintenance of the main elements of the irrigation system. When the river is dry in the summer, most men pursue the building of river dams, digging the river bed to find water before diverting it to a common pool. Huge rocks are lifted from the river bed to facilitate terrace irrigation. The architecture of the terraces is such that irrigated water can reach every garden and the sluices are opened in turn in each village at precise times of the week so that everyone gets a share. With climatic conditions changing rapidly, the inhabitants are not only concerned about garden irrigation but also drinkable water for the village. Shortage of water is an issue during the summer months, and maintenance of the waterworks is vital to ensure that the river flow can reach the lower terraces (Montanari, 2012, 2013).

4.3 Agdal: Seasonal grazing practices

Although nomadic seasonal transhumance was very common up to the 1950s between natural low and highland pastures, herding is now mainly sedentary, involving small flock of grazing goats or sheep. It takes place during particular periods, especially in the higher pastures of the valley, and is often supplemented by the addition of fodder harvested from the garden or the mountains, or even with hay when villagers can afford it (Bourbouze, 1999). However, in part of the High Atlas where transhumance

still occurs, a type of resource management institution known as the agdal system functions at a larger territorial level than that of the fraction and tribe (Domínguez *et al.*, 2013; Genin and Simenel, 2011). This method of managing common resources, designated as appropriation and management of the land, is still implemented by the *jama'a*, a status resulting from customary rights, which regulates access to a lineage territory and its resources. It is a geographical and agro-ecological space characterised by the physical environment and specific biotic resources (trees, pasture, and agriculture). These grazing practices are regulated and sustained by rigid opening and closing dates for usage of specific-collective pastures. Agdal are typically found in high mountain pastures and are the most widespread and formalised system of transhumance where good pastureland and water can be found after the winter snow and during the dry summer months. This system is important because traditionally, Berber pastoralists followed a pattern of seasonal migration, grazing herds at low altitudes during the winter and at higher altitudes in summer, allowing for the regeneration of pastureland during the months when the agdal were closed (Mahdi, 1999; Auclair, 1996).

5 Transmission of a vulnerable traditional herbal knowledge

Plant knowledge is common to both men and women in El Maghzen and distribution of this knowledge follows different paths. However, at the present time, transmission of plant knowledge and of other traditional subsistence activities is very fragile as the community is increasingly exposed to outside influences and interventions. For instance, children who often accompany their parents to the terraced gardens participate in weeding activities, help to prepare the terraces, or gather cow fodder in the nearby mountains. These are important locations for practical knowledge transmission. Within the community, transmission of plant knowledge for instance occurs mainly through women, and parents are a strong

vector within the family environment. In the household, girls learn mainly from their mother (41%) and their grand-parents (11%), and to a great extent by themselves (19%). This knowledge is acquired through watching other women preparing medicine in the house and when collecting medicinal plants in the garden, at the river or in the mountains. Overall, the family group, defined as parents, sisters, paternal aunt and uncle and community cohesion is very important and women learn equally through friends, and from the elderly people of the village (22%). Men's plant knowledge on the other hand, is also acquired from their mother but to a lesser extent (26%) and also from their grand-parents (6%). As with women, transmission occurs mainly within the family networks, and the transmission from these combined is greater than with women (38%). Many men claimed to learn by themselves (12%), but also from friends and acquaintances in the village (18%), and to a lesser extent from their fathers (Fig. 6).

Furthermore, most families store plants in the house. Eighty-three percent of women and 63% of men responded that they always had harvested supplies of plants in the house. Twelve percent of women and 37% of men responded that they did not. Men's higher responses are attributed to the fact that plant preparation and administration is usually done by women. Therefore, men may not always be aware that plants are available in the house. However, 5% of women mentioned that they did not always consume their own phyto-medicines, and that if allopathic medicine were available, would rather take that (Fig. 7).

Places and traditional activities where acquisition occurs are also important, and 53% of men are more likely to acquire plant knowledge during harvesting activities on mountainside than women (25%). On the other hand, women are more likely to acquire knowledge in indoor activities than men (47% for women and 12% for men). Both men and women, however, acquired knowledge in other contexts, for

instance in places such as the gardens and at the river, although gardens are generally more important for women than for men (35% for women and 28% for men) (Fig. 8). Men, on the other hand, tend to learn these traditional skills in activities while attending the building of river dams or digging the river bed to find water for the maintenance of irrigation, particularly during the summer when there is a shortage of water.

Overall, women and men indicated that they passed on herbal knowledge to their children and these were likely to acquire in indoor and outdoor activities. For 75% of women and 29% of men, this was reported as occurring at home. For instance, children were able to familiarise themselves with this knowledge during the preparation of herbal medicine for a sick family member in the house. Older members of the family (brothers, sisters, aunts or grand-parents) equally participate in this transmission to younger children, or sisters and brothers. Six percent of women and 16% of men reported that they showed the children plants while in the mountains. Women (6%) and men (15%) also reported to transmit this knowledge in settings like the river, garden and around the village. However, 13% of the women and 40% (of men) reported that they did not (Fig. 9).

These data suggest that the potential for knowledge erosion is related to work group composition and opportunities for sharing views on particular activities. Although the inhabitants of El Maghzen are strongly motivated to perpetuate their traditional knowledge based on good economic reasons, these data indicate that many traditional knowledge practices including those relying on plant knowledge, are vulnerable because their transmission depends on women's work in key places, such as the household, the gardens and to some extent the mountainsides. Women are central to the maintenance of the household equilibrium, and other outdoor activities and the transmission of knowledge to the younger generation take place through these channels.

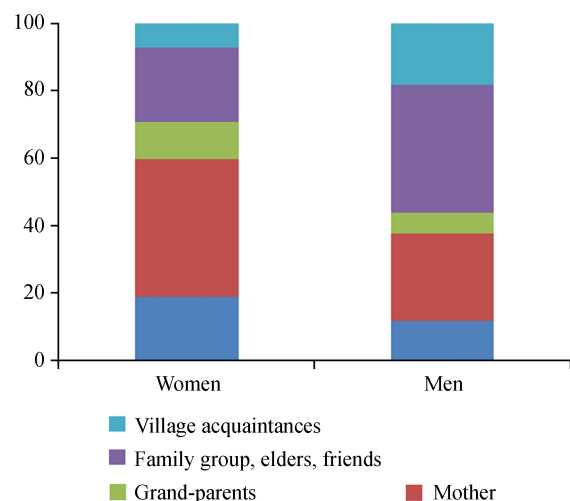


Fig. 6 Informants' pathways of plant knowledge acquisition

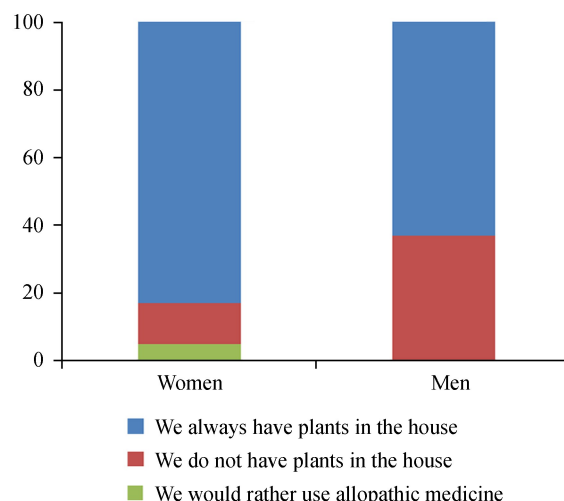


Fig. 7 Informants' responses to plant storage in the house

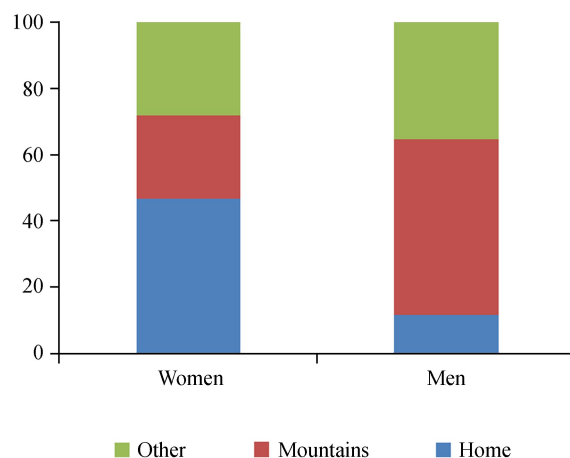


Fig. 8 Informants' places for plant knowledge acquisition

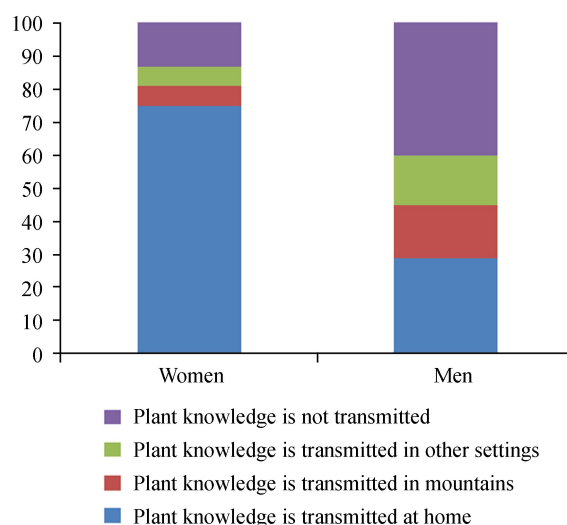


Fig. 9 Places of plant knowledge acquisition for children

While globalisation is gaining ground even in the most remote parts of the country and external development interventions and new financial opportunities arise, the pattern of traditional activities and the associated knowledge transmission is likely to change. For instance, one could anticipate that women will give up the activities that they perceive to be the most unrewarding within and outside the household.

6 Conclusion

As a crucial component for the management of natural resources, traditional ecological knowledge in El Maghzen has allowed the communities' subsistence

for centuries. These traditional skills and management practices have been shaped and re-shaped, to respond to particular problems and situations and to maintain specific survival objectives (Sillitoe, 2004; Sillitoe *et al.*, 2003). They have not only appropriately addressed the problems of living at high altitudes and limited space, but also buffered for extreme changing climatic conditions. As the younger generations move away to the cities to find employment, this traditional knowledge is imminently becoming vulnerable and will ultimately be lost. Its transmission to the younger members of the community is therefore crucial for the continuity to the future generations.

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